

NAME P/N QTY	CRIT	FAILURE MODE & CAUSES	FAILURE EFFECT	RATIONALE FOR ACCEPTANCE
PHASE VI TMG, ITEM 106 (1) LEFT (1) RIGHT ----- 0106-812144- 03/04(12V) (2)	2/2	106FM18N  Loss of heating ability.  Open wiring. Damaged LEMO plug connector or thermfoil heater elements.	END ITEM: Loss of electrical power to thermfoil heaters.  GFE INTERFACE: Loss of active heating in glove fingertip area.  MISSION: Terminate EVA.  CREW/VEHICLE: None.  TIME TO EFFECT /ACTIONS: Minutes.  TIME AVAILABLE: N/A  TIME REQUIRED: N/A  REDUNDANCY SCREENS: A-N/A B-N/A C-N/A	A. Design - The cable is constructed of 3 insulated high strength 24 gauge copper alloy wires P/N's M27500-24TN3S06 & M22759/11-24-9 (Single wire #24, stranded white) & M22759/11-24-96 (Single wire #24, stranded, white w/blue). Attachment to the TMG is achieved by whipstitching the cables, limiting relative motion between the cable and the TMG to resist abrasion to the extent possible. Two additional 24AWG wires are used that solder to the switch. This wire is soft copper to allow for soldering to switch terminals.  The effective heater diameter is 0.5 inches. The heater element assembly is a wafer configuration with the heater element grid sandwiched between Kapton film. The wafer is held together with acrylic adhesive. 30 AWG high strength copper alloy wire (complies with MIL-W-22759) is tack welded to the element grid.  The connectors are LEMO series K connectors which are environmental connectors with triple wall construction to provide water and dust resistance. The LEMO connectors utilize a "Quick Lock" feature that assures connection when the lock is engaged. The locking mechanism is protected by a rugged outer shell, eliminating accidental disconnections and damage to the locking mechanism, cable, or contacts. The connectors have a contact arrangement of five pins and are mechanically keyed with an alignment key on the shell which prevents errors in alignment. The contact terminations are crimps, performed per NHB 5300.4 3(H).  A crafted metal collet type strain relief is provided to secure the cable around its circumference, preventing accidental damage to the connection if the cable is stressed. In addition, a shrink tubing strain relief is placed over the end of the LEMO connector at the junction of the cable to the connector to provide additional strain relief. The connectors meet the electrical requirements for both voltage and current derating per MIL-STD-975.  B. Test - Acceptance: See Inspection.  PDA: The connectors undergo 100% visual inspection when received from the vendor. Crimp and solder joints are visually inspected by Government Quality Assurance Inspectors when fabricated. In addition, the cable assemblies are visually inspected and electrical continuity, insulation verification, and electrical bond testing are performed during PDA.  Certification: The system was successfully tested (manned) during certification testing to duplicate operational usage (Ref. Certification Test Report for the 12V Phase VI Glove TMG (ILC Doc. 0111-712701). The following usage reflecting requirements of significance to the TMG was documented during certification testing. The S/AD applies 229 hours in certification while the actual indicates 157 hours toward the Phase VI, 12-volt TMG in the Hamilton Sundstrand Limited Life Items list (EMU1-19-001).  Requirements S/AD Actual -----

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106FM18N

Finger Flexion/Extension	45142	31096
Wrist Flexion/Extension	12646	9568
Wrist Adduction/Abduction	17104	11960
Wrist Rotation	20112	14144
Electrical Connector	150	174
ORU TMG Installation/Removal	49	38

Electrical verification tests conducted at each of seven Interim Test Points determined that the cable was functional throughout certification testing.

C. Inspection -

The connectors undergo 100% visual inspection when received from the vendor. In addition, the cable assemblies are visually inspected and electrical continuity, insulation verification and electrical bond testing are performed during PDA.

D. Failure History -

I-EMU-106-A008 (8/24/00) - Glove heater wire found pulled out of left little finger in 3 Volt TMG during PDA functional testing. Tracked by J-EMU-106-A004.

J-EMU-106-A004 (7/31/00) - Right 3-Volt TMG heater circuit failed continuity during STS-106 pre-flight testing. A load greater than 2.8 lbs. was imparted to a single wire, which subsequently failed at the crimp. TMG installation & removal requires unavoidable inversion and manipulations of TMG, and this failure only occurs during this time. Failure is inherent in design and not likely to occur during Class I use. Pre-flight screens exist to detect heat anomalies. Product enhancement recommended for long term solution.

J-EMU-106-A006 (10/5/00) - DC resistance fluctuated high during TMG (12V) heater circuit test. Electrical bond degraded between fuse endcap and element while soldering harness lead wire to fuse. ECO 002-0359 adds aluminum heat sink.

I-EMU-106--010 (7/7/00) - Left index finger inoperative. Most probably caused by repeated flexing of heater wire in fixed position. Occurs only during TMG installation or removal. ECO 002-0341 modifies work instructions. CCBH H7115 adds resistance test to FEMU-R-001. Screened prior to EVA.

J-EMU-106-F002 (1/18/01) - During STS-97 post-flight testing, glove failed heater continuity test. Investigation revealed broken fuse element and broken wire in TMG harness. Long term corrective action to make glove heater system more robust has been proposed.

E. Ground Turnaround -

Pre flight heater functional test and heater circuit quantitative resistance test.

F. Operational Use -

1. Crew Response -

Pre-EVA/Post EVA: Troubleshoot problem. If unsuccessful, use alternate gloves. If no alternate gloves are available, EMU no-go for EVA.

EVA - If loss of fingertip heating occurs in one glove, terminate EVA. If loss of fingertip heating occurs in both gloves, turn off power from battery, terminate EVA.

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		106FM18N		2. Special Training - None.  3. Operational Considerations - Not Applicable.

EXTRAVEHICULAR MOBILITY UNIT  
SYSTEMS SAFETY REVIEW PANEL REVIEW  
FOR THE  
I-106 GLOVE ASSEMBLY  
CRITICAL ITEM LIST (CIL)

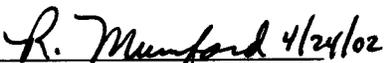
EMU CONTRACT NO. NAS 9-97150

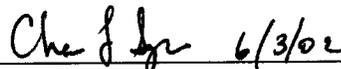
Prepared by:   
HS - Project Engineering

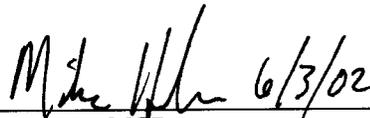
Approved by:  22mar/02  
NASA - SSA/SSM

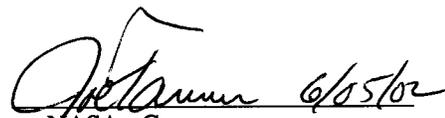
  
HS - Reliability

 5/23/02  
NASA - EMU/SSM

 4/24/02  
HS - Engineering Manager

 6/3/02  
NASA - S & MA

 6/3/02  
NASA - MOD

 6/5/02  
NASA - Crew

 6/3/02  
NASA - Program Manager